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# WASTE OF FUEL AND ITS INFLUENCE IN INDUSTRY

*By* E. G. BAILEY, '03

[The following paper was read by Mr. Bailey before one of the meetings held during Good Management Week last autumn. Mr. Bailey graduated from Ohio State in the class of 1903, and is president of the Bailey Meter Company, Cleveland, Ohio, and of the Fuller Lehigh Company, Fullerton, Pennsylvania.]

SO much has been written upon the technical points of fuel waste and the financial gain through its elimination that it seems to me rather useless to repeat indefinitely the same points which every engineer knows so well and every manager of an industrial plant has been told so many times. I therefore would like to bring out a few points in connection with the psychology of our industrial leaders' attitude toward this waste of fuel.

All industrial plants are not lax in questions of fuel economies, but on the average they have fallen behind the central station. While the latter are not entirely free from criticism in connection with the waste of fuel, yet they have approached this subject much more seriously and have effected tremendous savings in fuel in producing their product, electricity.

The usual explanation as to why central stations have been much more active in fuel economy than have industrial plants is that fuel comprises a much larger percentage of the total operating cost than in the case of an industrial or manufacturing plant. This is true to a certain extent but it in no way explains the wide diversity between the method of approach of this problem between the two classes of fuel users.

While the central station industry has grown by leaps and bounds to a place of great importance it has been to no small extent due to the difference in the attitude which they take toward the matter of fuel and other economies in operating their industry as compared with industrial plants generating their own power. Industrial plants requiring power only are rapidly becoming customers of the central stations, because they can purchase power cheaper than they can generate it in their own plant.

There are many industries which have process requirements for direct heating by fuel or steam which will continue to burn their own fuel instead of purchasing power from the central station industries. It is this particular type of industry that I wish to emphasize the need for study into the question of fuel waste and its influence upon their industry.

The generation and sale of electricity started barely fifty years ago, almost simultaneous with the first boiler testing and serious study of combustion efficiency which took place in connection with the Centennial Exposition in 1876. It was not until about twenty-five years later that the central station industry began to develop rapidly and serious attention was focused on fuel economy and power costs.

At that time there was much discussion in engineering circles between central station power versus industrial plants developing their own power. The chief engineers and employees in the power plants of the industries resented the incoming of central station power because it often meant the loss of their jobs or at least so they considered it. Furthermore, the chief engineer of the plant was often unable to put forth the best argument that would appeal to his manager as to why he should not buy central station power if it showed an economy in dollars and cents. The manager of the industrial plant was normally inclined to operate his own plant for he had everything under his control for reliability of operation, etc. The manufacturers of power plant equipment and the publishers of engineering periodicals all leaned toward the individual industrial plant and their influence and recommendations were in that direction because it looked to them like more business and more subscribers and more advertising to have a large number of small plants scattered over the country rather than a few large ones.

However, in spite of all this, the economic laws of nature have worked out, illustrating the survival of the fittest and the central station has today largely taken over the industrial plant as customers and the argument seldom arises in the same controversial form which it did ten to twenty years ago.

Within this period of time the pounds of coal per kilowatt hour have been reduced from over three to less than one and one-half, and some of the more modern plants are generating a kilowatt hour on one pound of coal or less, or expressed in modern terms, between 13,000 and 14,000 B.t.u. per kilowatt hour.

At the same time this reduction in coal consumption has taken place, the output of fuel burning furnaces and boilers has been increased until today there are substantially five times the kilowatt hours being produced from a given boiler heating surface, than was common practice fifteen years ago. The investment in auxiliaries and supplemental equipment per square foot of boiler heating surface has increased so this should not be misconstrued as a ratio of output per capital investment.

The net result, however, is shown in the much repeated relationship between the cost of living and the cost per kilowatt hour, as measured from the pre-war period until the present time, which shows the cost of power materially less while the cost of living has increased some fifty per cent.

In spite of the fact that the same boilers, the same stokers, the same pulverized coal burning equipment, and other power plant accessories are available to the industrial plant as to the central station there has not been the same progress in efficiency and capacity in burning fuel in the two instances.

We might go further and say the engineers in the industrial plants read the same magazines, the same books, belong to the same engineering societies, and receive, if they wish, the reports of the committees of the central station industries; they are free to visit central station power plants and learn all they can as to the latest methods of using fuel, yet there is unquestionably a decided

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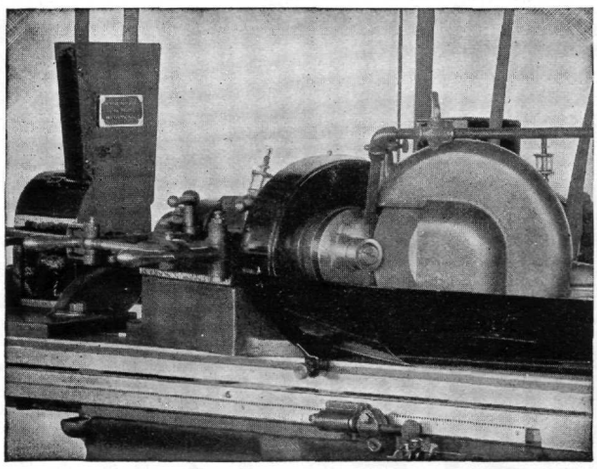

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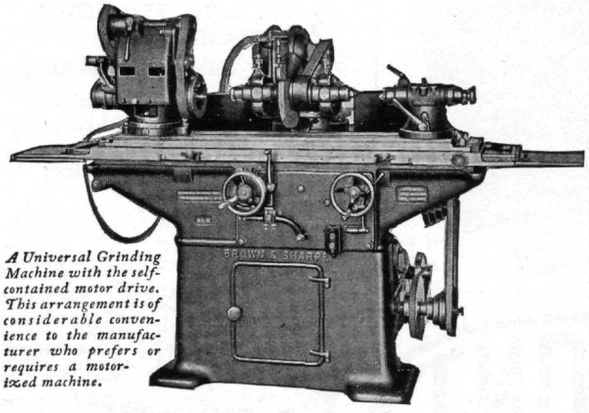

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## WASTE OF FUEL AND ITS INFLUENCE ON INDUSTRY

(Continued from Page 6)

difference in the average efficiency obtained in the two types of plant.

The industrial plant manager will endeavor to explain this by the larger percentage of the fuel cost in the production of electricity than in spinning textiles, making boots or shoes, or even producing rubber, paper and iron or steel. The central station industry, however, has looked upon the purchase of power plant equipment as an economic investment of so many dollars to bring certain returns in the saving of fuel. The industrial executive should in the same manner look upon the investment of certain equipment and see what returns it would bring in the way of increased capacity and efficiency in the burning of fuel and development of power in his own plant. I am afraid some of our industrial executives have not seriously analyzed this question. For instance, some of the largest industries in this country have earned profits beyond what they could normally reinvest in their own processes, and they have invested their surplus in other unrelated industries or in restaurants, hotels, etc. Many of these outside investments brought in only nominal returns, while their own power plants continued to belch forth smoke and supply the poorer families of their neighborhood with coke from their ash pile. The opportunities for investing money in power equipment in their own plant are often much greater than any safe investment that could be made elsewhere.

One time the vice-president of one of the largest industries in this country said to me when we were discussing the question of purchasing some equipment to improve the efficiency of his power plant, "If the central stations are using this equipment I do not want to use it." This was so unusual a reply to the argument which I had often found effective in arousing the interest of an industrial plant manager that I asked him if he would mind explaining to me just why he had reached that conclusion. His reply was that the central station industry could secure capital at a low rate so that they could well afford to invest their money and receive only nominal returns on it, while his company had adopted a policy that no expenditure should be made in their plant unless they were sure of receiving a return of at least forty per cent on every dollar invested.

I told him there were many investments that central stations made in certain fuel saving equipment that often resulted in fifty to one hundred per cent returns, and I felt it was much better to consider each problem on its own merit rather than arriving at generalities and sweeping conclusions in connection with such a matter.

This illustration is used to point out the psychology of the situation. It seems that the managers and financiers of industrial plants have, as a class, formed definite conclusions that their plants must be less efficient, they must be dirty, they must be poorer kept than central stations. There are exceptions of course to this rule and many industrial plants are kept up in as modern and efficient condition as the central stations, but speaking of the average they are imbued with the idea that investment in fuel saving equipment is not economical and they take little pride in that

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end of their business. Oftentimes these plants have in their employ engineers who are very competent and would be very glad to proceed with the installation and use of fuel saving equipment, modern boilers, etc., yet they cannot obtain the appropriation nor are their efforts to obtain the best results from the equipment at hand received with the encouragement which they deserve. Such treatment usually results in the good men leaving the employ and going to another type of plant where his services and efforts will be more appreciated or else he loses courage and drifts into an attitude of indifference.

Perhaps the management is often justified in withholding expenditures for fuel saving equipment for improvement in its power plant due to having made such investment and failed to realize the promised returns. This condition has often resulted from the over-enthusiasm of the salesman or the over-statements of the manufacturers, and they have tried to put equipment into a place where it would not return its proper profit to the investor. This is a short-sighted and poor policy on the part of the manufacturer and cannot help but retard the entire progress of fuel saving equipment. It is the duty of the buyer to check up on the reliability and standing of the manufacturer to make good his claim.

Again the management of industrial plants often buy the cheap or "just-as-good" equipment from a manufacturer that does not have an organization of competent engineers to stand back of and service their equipment. This is naturally an unwise investment which often results in a much greater expenditure to make it operate or keep in repair than if they had installed good equipment in the beginning. The efficiency and reliability of such equipment usually bears a close relation to its initial cost.

Many industrial plants fail to make good returns upon the investment because of the incompetence of the engineer in charge. The management should select men for this important position with great care. Every manufacturer of power plant equipment can name many instances where his equipment has shown up to poor advantage and the plant owner has wasted a great deal of fuel because the chief engineer was selected or retained for some reason other than his ability to do his work well.

Many plants are operated by chief engineers or master mechanics that are excellent men to maintain and operate the equipment already installed, but are not qualified by training or experience to decide the important questions which may come up in selecting equipment for an extension to the plant, the building of a new one or changing over from oil to coal, the decision between stokers and pulverized coal and many such problems that are ever changing as new developments are made.

The procedure as I see it is for the industrial plant executive to realize that in his power development he has the choice between purchasing power and generating it from his own improved or newly designed plant. His local conditions will largely influence the decision as much depends upon the use of direct heat or steam in

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process work or perhaps even heating of the plant itself. In arriving at this decision he might well secure the services of a competent consulting engineering firm who are capable of making a power survey of real value and who will take into account all factors relating to his particular location and requirements.

If the decision reached from such a study leads to the installation of a new plant or improvement of the existing one, he should then look upon the entire procedure as an investment that requires very careful analysis before deciding what fuel is most economical to burn, and other important points.

The power plant design of twenty years ago was much more standardized than it is now. In fact there is greater diversity of equipment than ever before. To decide between the use of coal, gas or oil fuel or between different kinds of coal according to the geographical location is not always a simple problem. Then the question of stokers or pulverized coal; and if pulverized coal whether bin or unit systems, and what make of equipment. Other questions such as steam pressure, air heaters, economizers are so important and extensive that it undoubtedly pays to call in a gool consulting engineer having had wide experience in these matters and let him lay out the plant and select or purchase the material and equipment best fitted for its respective purpose, and after doing so place the operation in the hands of competent engineers and give them enough attention and cooperation so that they will put forth their best effort in maintaining and operating the equipment to realize the returns on the investment.

The equipment should of course be purchased from reliable manufacturers who have pride in their product and will cooperate with the user in obtaining the best results in its use.

Even outside of the return on the investment and the pride of having a well run power plant, everyone should keep in mind the conservation of our natural resources. Whenever a proposition regarding the expenditure for power equipment breaks almost even in relation to cost and efficiency, preference should be given to that which results in the saving of fuel as a matter of conservation.

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# HOW MANY OF THESE QUESTIONS CAN YOU ANSWER CORRECTLY?

THE following questions pertaining to explosives or to industries in which explosives are used should afford some pleasure and instruction for those who follow the popular indoor sport of "Ask Me Another".

The answers* to these questions are published in the May, 1927 issue of The Explosives Engineer magazine.

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## QUESTIONS

1. (a) Who discovered nitroglycerin.
   (b) Who invented nitroglycerin dynamite?
2. What blasting supplies should never be transported or stored with explosives?
3. What high explosive is a liquid?
4. (a) Who was the first director of the United States Bureau of Mines?
   (b) Who is the present director?
5. What are the three ingredients of blasting powder?
6. Does safety fuse burn slower, at the normal rate, or faster when tightly tamped in a bore hole?
7. What electrical instrument is used for testing electric blasting caps and blasting circuits?
8. Name two of the three methods of blasting boulders. Name first the method that requires the least amount of explosive and the one which requires the most explosive, last.
9. What is the velocity of detonation of Cordeau-Bickford?
10. When, where and by whom was coal discovered in America?
11. What is the best connection for electric blasting caps when fired by a power circuit when ample current and voltage are available?
12. What type of explosive is the most water-resistant?
13. What is generally considered the best explosive ingredient for use in detonators?
14. How many pounds of black blasting powder in a standard keg?
15. Give the four conditions prescribed by the United States Bureau of Mines requisite for a Permissible explosive.
16. Name three types of high explosives commonly used for industrial purposes.
17. What magazine publishes a monthly digest of articles relating to drilling or blasting that have appeared in the technical press of the world?
18. What are the standard granulations in which black blasting powder can be obtained?
19. Name the secretaries of the following associations:
   (a) American Mining Congress.
   (b) American Institute of Mining and Metallurgical Engineers.
   (c) American Zinc Institute.
   (d) National Crushed Stone Association.
   (e) Associated General Contractors.
   (f) National Slate Association.
20. What great railroad tunnel has recently been holed through?
21. How should safety fuse be cut for insertion in a blasting cap?
22. Of what material should a tamping stick be made?
23. How should empty dynamite cases be disposed of?
24. What state consumes more explosives than any other state in the United States?
25. What explosive is referred to as "The New Aladdin's Lamp"?

# THE EXPLOSIVES ENGINEER

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*Through the courtesy of THE OHIO STATE ENGINEER the answers are also printed on Page 28 of this magazine.